Bone Composition in Osteoporosis

Beamline: U10B, U2B

Technique: Infrared microspectroscopy

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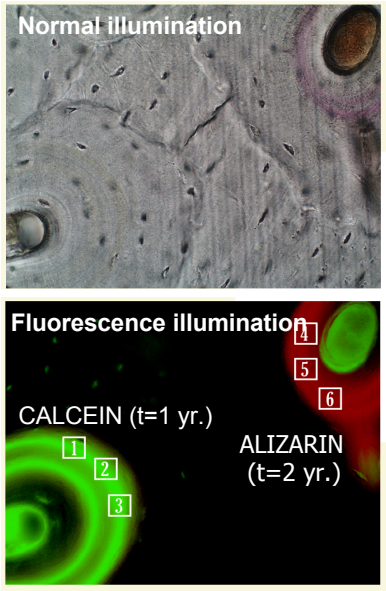
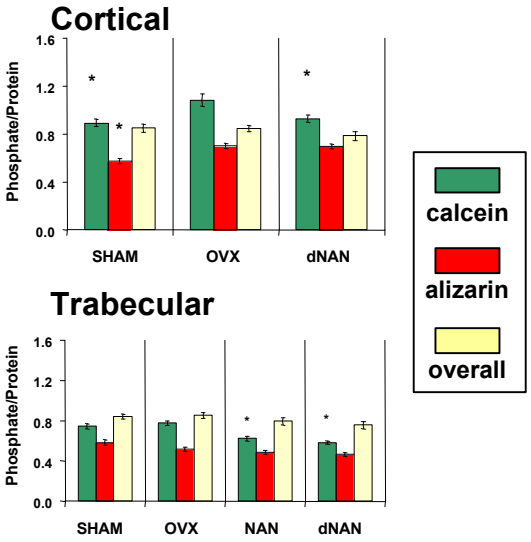
Motivation: Reduced bone density is a well-known feature of osteoporosis, yet little is known about the changes in the chemical composition of bone or the impact of such chemical changes on fracture risks. Using ovariectomized cynomolgus monkeys as a model for the menopausal onset of osteoporosis, we examined the microscopic chemical changes of bone measured by synchrotron infrared microspectroscopy as a function of time after ovariectomy.





(Left) Light microscope (top) and fluorescence microscope (bottom) images of of cortical bone. Fluorescent labels indicate bone that produced 1-year (green) and 2-years (red) after ovariectomy. (Right) Phosphate/protein ratios for cortical (top) and trabecular (bottom) bone in the control, ovariectomized, and nandrolone-treated animals.

Results: The results demonstrate that cortical bone formed one or two years after ovariectomy and identified by fluorochrome labeling has a higher phosphate content (phosphate/protein ratio), a lower carbonate content (carbonate/protein ratio), and more mature collagen crosslinks (non-reducible crosslink/reducible crosslink ratio) than that formed in control animals. Trabecular bone after ovariectomy shows no changes in phosphate content, a lower carbonate content, and immature collagen crosslinking. Treatment with a bone turnover suppressor (nandrolone decanoate) reverses most of the ovariectomy-induced chemical changes in the cortical bone to the levels of the ovary-intact controls, but has little effect on the trabecular bone. These results demonstrate that bone newly synthesized after ovariectomy is chemically different from healthy bone within specific bone regions, which may contribute to a greater likelihood of microfractures and eventual loss of bone stiffness in osteoporosis.